

## FLEXIBLE HANDLE FOR SLIPS USED IN WELL OPERATIONS

CROSS-REFERENCES TO RELATED APPLICATIONS      Not Applicable

5      FEDERALLY SPONSOR RESEARCH OR DEVELOPMENT      Not Applicable

SEQUENCE LISTING, TABLE, OR COMPUTER LISTING      Not Applicable

### BACKGROUND OF THE INVENTION

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#### 1. Field of the Invention

[0001]      This invention relates generally to the field of well drilling equipment. More particularly, the invention relates to the field of well tubular handling equipment.  
15      Specifically, the invention is a flexible handle for a slip used in well operations.

#### 2. Description of the Related Art

[0002]      The present invention pertains to an improvement in the safety and handling  
20      of slip-type assemblies for gripping and suspending objects, especially tubular goods. In the course of well drilling operations, tubular goods are made up, that is, connected together into strings, and lowered into the well. These tubular goods include drill pipe, production tubing, known as casing, drill collars, rods, and the like. Drill pipe is a principal example and will illustrate the processes involved. The drill pipe are made up  
25      and lowered into the well by attaching sections of pipe one at a time to the upper end of the pipe strings, which are suspended in the well. Similarly, the pipe strings are broken up and raised from the well by a reverse operation, that is, by detaching the sections one at a time. While this work is being carried on, the made up portion of the pipe strings must be maintained, suspended in the well. Since wells may be drilled to a great  
30      depth, means must be provided for securely holding the drill pipe so that the suspended pipe strings do not drop into the well. Slips are provided for that purpose.

**[0003]** In a typical well drilling operation, a platform is used which supports a circular rotary table. Sufficient rotational energy is supplied to the rotary table through motors or the like. This energy moves the rotary table in a circular fashion. The rotary table supplies a master bushing, which provides a central opening or bore through which the drill string passes. A kelly bushing is interlocked with the master bushing and drives the drill stem. The rotary table, kelly bushing, and master bushing are art terms which refer to the various parts of the drilling rig which actually impart the needed rotational force to the drill string to effect drilling. Such well drilling equipment is well known in the art.

**[0004]** When adding or removing a joint of pipe from the drill string, wedges which are called slips are positioned into the rotary table central opening into a bowl to wedge the drill pipe, preventing its fall into the well bore. Often, placement of the slips is manual. Thus, slips or slip assemblies (a plurality of slips linked together) usually provide handles for gripping and lifting by the well personnel. When the pipe is disconnected using a power tong or the like, the remaining portion of the drill string can be supported by slips so that additional sections of pipe can be added to or removed from the drill string.

**[0005]** In the oil industry, slips have been necessary elements of oil field drilling equipment for many years. Classic manual slips are sets of heavy hinged blocks with gripping dies that are positioned in a slip bowl of a rotary table to engage drill pipe or casing. Angled surfaces in each slip block mate with angled surfaces in the slip bowl. The angled surfaces cause axial forces exerted by the pipe on the blocks to be transferred into lateral gripping pressure on the pipe to support the pipe and thus prevent it from slipping through the slips. Manual slips are engaged by oil field personnel who physically maneuver the heavy slips into the slip bowl so that they slide into engagement with the drill pipe. The slips are disengaged by upward axial movement of the drill pipe to take the weight off the slips. The slips are then lifted out of the slip bowl to disengage them from the drill pipe and permit their removal from the slip bowl, if desired.

**[0006]** Each time that a length of pipe is added to or removed from a drill string, the string must be temporarily supported by slips positioned within a tapered slip bowl structure in a rotary table. After the desired length of pipe has been added or removed,

the slips are released to permit vertical movement of the string. On occasions when the entire string must be removed from the well, as for replacement of a bit or for other similar purposes, the necessity of repeated movements of the slips into and out of active position in first successively breaking a large number of connections in the string as it is removed from the well, and then remaking these connections when the string is again lowered into the well, results in the expenditure of a great deal of time and effort just in slip handling. Where the slips are handled entirely manually, their usually very substantial weight renders it rather difficult for the workmen to lift the slips into and out of the bowl, and there is also an ever present danger of injury in such handling of the slips.

**[0007]** Physical movement of slips by personnel is somewhat dangerous and time-consuming. Mechanical equipment to move the slips has also been utilized in the past to alleviate the physical handling. Additionally, various types of power slip arrangements have been employed, in which a power operated unit has been employed to suspend the slips above the slip bowl, and in some way utilize power for effecting at least a portion of the slip movement. Some of these power slip units have been effective in operations, but many drilling companies have continued to use manual slips. This is because of the high cost of power slip units, and because most power slip units require permanent attachment of a support post or other structure to the rig floor at the side of the rotary table. Space is at a premium on the rig floor, and many drillers hesitate to occupy a portion of that space permanently by equipment which during much of the time will not be in use and may interfere with other operations. Therefore, drilling rigs are still usually equipped with manual slips.

**[0008]** In the process of well drilling, tripping out refers to the process of removing and/or replacing drill pipe from the well. This happens when it is necessary to change the drill bit or other piece of the drill string, or when preparing to run certain tests in the well bore. Tripping out typically comprises the following activities. The floor crew sets slips around the drill string. The crew breaks out and sets back the drive mechanism for the drill stem, setting it aside. The crew attaches elevators to elevator links. The crew latches the elevators onto the pipe. The crew climbs up the derrick, unlatches the elevators, and guides the stands of pipe into the fingerboard. The elevators are then

lowered and attached to the next stand of pipe. The crew uses tongs and cathead to break out the pipe. Finally, the stand of pipe is raised and maneuvered to the pipe racking area.

**[0009]** Tripping in comprises almost the same steps in reverse order: raising the elevators, latching the elevators to the top of stand, moving the pipe to the rotary, making up the pipe, pulling the slips, setting the slips, unlatching the elevators, repeating the process for all stands, picking up the drive mechanism and attaching it to the drill string, breaking circulation, and resuming drilling.

**[0010]** Several of the above steps involve working with and around the slips. There are many potential hazards. For example, in setting the slips, body parts, in particular hands and fingers, can be pinched between the slips or slip handles and the rotary table. In breaking out and setting back the drive mechanism, workers could be struck by the slip handles if the rotary table is used to spin the drill string. Similarly, during breaking out the pipe, the rotary table may be used to spin the pipe after breaking connection. Again, workers could be struck by the slip handles. In general, being struck by the slip handles of a spinning slip during well operations is a potential hazard for well personnel.

**[0011]** Traditionally, slip handles have been made of hard materials, such as metal. Hard materials are not flexible and they do not give or bend on accidental impact. Thus, slip handles made of hard materials contribute to greater risk of injury to well personnel when the slip is rotating during normal well operations.

**[0012]** Slip handles made of flexible materials, such as polyurethane or rubber, have been tried, but they are typically not strong enough. Flexible slip handles typically stretch and break. Sometimes flexible handles deform and remain bent or twisted. A bent or twisted handle can cause a worker to use an awkward or dangerous stance in handling the slip. An improper stance is conducive to personal injury.

**[0013]** Slip handles made of flexible segments with metal cable inside have also been tried, they are not durable. The internal cable inevitably cuts the flexible cover. A handle must still be strong enough to perform the job of lifting and holding the slip during repetitive use. A slip handle that breaks during use also contributes to the risk of personal injury. Additionally, breaking slip handles leads to the increased costs of

downtime and equipment replacement.

**[0014]** Thus, a need exists for a safer slip that decreases the risk of injury to the workers from being struck by spinning slip handles. Thus there exists a need for a slip handle that is flexible enough to give on impact, strong enough to lift the slip assembly  
5 without deforming or breaking, and durable enough to maintain its shape for safe handling.

## BRIEF SUMMARY OF THE INVENTION

10 **[0015]** The invention is a flexible handle for a slip. The handle comprises a first element, wherein the first element is attached to the slip; a chain connected to the first element; a second element connected to the chain, wherein the second element is configured as a handle; and a flexible sleeve encompassing the chain and attached to the first and second elements.

15 **[0016]** In a preferred embodiment, the chain is composed of four links of zinc plated 3/16 inch, 700 pound strength chain links and the flexible sleeve is composed of molded polyurethane.

## BRIEF DESCRIPTION OF THE DRAWINGS

20 **[0017]** The invention and its advantages may be more easily understood by reference to the following detailed description and the attached drawings, in which:

**[0018]** FIG. 1 is a side plan view illustrating typical well drilling equipment with which the present invention would be employed;

25 **[0019]** FIG. 2A is a side plan view illustrating an embodiment of the invention for a flexible handle for a slip, showing the inner chain; and

**[0020]** FIG. 2B is a side plan view illustrating an embodiment of the invention for a flexible handle for a slip, showing the flexible sleeve;

**[0021]** FIG. 3A is a top plan view illustrating an embodiment of the invention for a flexible handle for a slip, showing the inner chain; and

30 **[0022]** FIG. 3B is a top plan view illustrating an embodiment of the invention for a

flexible handle for a slip, showing the flexible sleeve.

**[0023]** While the invention will be described in connection with its preferred embodiments, it will be understood that the invention is not limited to these. On the contrary, the invention is intended to cover all alternatives, modifications, and equivalents that may be included within the scope of the invention, as defined by the appended claims.

## DETAILED DESCRIPTION OF THE INVENTION

**[0024]** The present invention relates to improving slips for supporting a well pipe in a rotary table. The present invention is a flexible handle for a slip. The slip with which the present invention is embodied includes, but is not restricted to the following types of slips: a rotary slip, a drill pipe slip, a casing slip, a drill collar slip, or a conductor pipe slip. This list is inclusive and not intended to be a limitation on the invention.

**[0025]** FIG. 1 is a side plan view illustrating typical well drilling equipment deployed on a well rig floor 101, with which the present invention would be employed. A conventional well drilling rotary table 102 is illustrated diagrammatically, containing a central opening 103 through which a well pipe 104 extends vertically along a central axis 105. A master bushing 106 is supported by the rotary table 102 within opening 103 and is driven rotatively with the rotary table 102. In one typical embodiment, the master bushing 106 has an upper externally square portion 107 received within an upper square portion 108 of the opening 103 in the rotary table 102. In an alternative typical embodiment (not shown), the master bushing 106 is interconnected to the rotary table 102 by pins. Internally, the master bushing 106 has a central vertical opening 109 having an annular upwardly facing shoulder 110 near its upper end for supporting a slip bowl structure 111 in the master bushing 106.

**[0026]** The slip bowl structure 111 is adapted to be received and supported within the opening 109 in the master bushing 106. The slip bowl 111 may be formed having outer cylindrical surfaces engaging the inside of the master bushing 106, and having downwardly facing arcuate shoulders engageable with and supported by the shoulder 110 in the master bushing 106. Internally, the slip bowl 111 contains radially inward

facing vertically extending recesses within which slips 112 are received and guided for vertical movement. The outer wall of these recesses form camming or wedge surfaces 113 and which advance radially inward as they advance downwardly, to engage corresponding camming or wedge surfaces 114 on the slips 112. The slip bowl surfaces 114 are stepped outwardly relative to the slip surfaces, so that by a relatively short upward movement of the slips 112, the slips 112 can move radially outward a very substantial distance to provide a very open central passage in the assembly for upward and downward movement of the well pipe 104. The opposite side surfaces 115 of the slips 112 may be parallel to one another and vertical, and contact correspondingly parallel and vertical planar surfaces 116 at opposite sides of the recess within which the slip 112 is received, to effectively transmit rotary motion about the axis 105 from the slip bowl 111 to the slips 112, while permitting upward and downward movement of the slips 112 relative to the slip bowl 111. The radially inner surfaces 115 of the slips 112 typically have teeth following essentially the surface 116 of the curvature of the well pipe 104 and adapted to grip and support the well pipe 104 when the slips 114 are cammed inward against it. The slips have pivotally attached handles 117 for handling. These handles 117 are the subject of the invention.

**[0027]** FIGS. 2A and 2B are side plan views illustrating an embodiment of the invention for a flexible handle for a slip used in well operations. FIG. 2A shows the flexible sleeve open to reveal the chain within, while FIG. 2B shows the flexible sleeve intact. A slip handle, designated generally by reference numeral 200, is comprised of a first element 201 and a second element 202 connected by a chain 203. The first element includes a first end 204 and a second end 205. Similarly, the second element includes a first end 206 and a second end 207. The chain 203 is connected to the first element 201 by the chain 203 interlocking with a loop 208 attached to the first end 204 of the first element 201, or any appropriate means of connection. Similarly, the chain 203 is connected to the second element 202 by the chain 203 interlocking with a loop 209 attached to the first end 206 of the second element 202, or any appropriate means of connection.

**[0028]** In a preferred embodiment, the chain 203 comprises four links 210. In a preferred embodiment, each link 210 is composed of 3/16 inch chain link. In a preferred

embodiment, each link 210 is zinc plated. In a preferred embodiment, each link 210 has 700 pound strength. This combination of size and material provides a slip handle of appropriate length and strength. When the handle 200 of the invention is used to pick up or to install the slip, the force pulling on the handle 200 is transferred to the chain 203. Thus the length of the handle 200 does not change length and the handle 200 is fully functional.

**[0029]** A flexible sleeve 211 is connected to the first end 204 of the first element 201 and is also connected to the first end 206 of the second element 202. The flexible sleeve 211 encompasses the chain 203. The flexible sleeve 211 can be composed of any material that is appropriately flexible and durable. In a preferred embodiment, the flexible sleeve 211 is composed of molded polyurethane. In a further preferred embodiment, the molded polyurethane has a durometer value of 90A – 50D. This material gives the desired combination of strength, flexibility, and durability to the slip handle 200. It has been seen that a cable cannot be used instead of the chain 203 inside of the handle 200, because the cable would cut the polyurethane due to the internal loading of the polyurethane.

**[0030]** The first element 201 is adapted to couple to a slip (not shown). In a preferred embodiment, the second end 205 of the first element 201 is adapted to couple pivotly to the slip.

**[0031]** The second element 202 is configured as a handle 212. The second element 202 is configured in any appropriate manner that acts as a handle 212. In a preferred embodiment, the second element 202 is configured to include a loop 213, adapted to act as a finger or hand guard. In another embodiment, the second element 202 is configured to include an extension 214 at the second end 207 of the second element 202, adapted to act as a thumb guard.

**[0032]** FIG. 3 is a top plan view illustrating an embodiment of the invention for a flexible handle for a slip used in well operations. FIG. 3A shows the flexible sleeve open to reveal the chain within, while FIG. 3B shows the flexible sleeve intact. The top view again shows the first element 201 and the second element 202 connected by the chain 203. The top view further illustrates how the second end 205 of the first element 201 is adapted to couple pivotally to the slip. In a preferred embodiment, the second

end 205 of the first element 201 is configured as a clevis 215.

**[0033]** The flexible handle of the invention, as illustrated in the above embodiments, will allow for up to of bending movement about the mid-point of the handle. The handle will bend or flex while maintaining a constant length. The flexible section in the middle of the handle accomplishes this. Because the handle is flexible, it will provide safety or give if it is hit or hits any personnel or equipment during use. This will provide protection to both personnel and equipment.

**[0034]** The key to the handle's flexibility is the chain located inside the polyurethane flexible sleeve. The chain will flex or bend at each of its links and minimize the internal stress on the polyurethane. Minimizing the internal stress will prevent the polyurethane from breaking or cracking. The 170° bending is 360° around the length of the handle.

**[0035]** As illustrated in the embodiments discussed above, the slip handle of the present invention provides the following advantages over conventional slip handles.

**[0036]** (1) The slip handle of the invention is flexible enough to bend on impact. This ability to give reduces the risk of accidental injury to workers when the slip is rotating. A primary benefit of use of the present invention is increased worker safety.

**[0037]** (2) The slip handle of the invention is durable enough to maintain its shape after bending. This ability to not remain twisted or bent contributes to safe handling. A bent or twisted handle can cause a worker to use an awkward or dangerous stance in handling the slip that is conducive to personal injury. A bent or twisted handle would also have to be replaced. Thus, use of the present invention reduces the cost of downtime and equipment replacement.

**[0038]** (3) The slip handle of the invention is strong enough to resist breaking in use. The handle must still be strong enough to perform the job of lifting the slip assembly. This ability to resist breakage reduces the danger of personal injury. Additionally, a broken handle would have to be replaced. Thus, use of the present invention again reduces the cost of downtime and equipment replacement.

**[0039]** It should be understood that the preceding is merely a detailed description of specific embodiments of this invention and that numerous changes, modifications, and alternatives to the disclosed embodiments can be made in accordance with the disclosure here without departing from the scope of the invention. The preceding

description, therefore, is not meant to limit the scope of the invention. Rather, the scope of the invention is to be determined only by the appended claims and their equivalents.